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To Study the Properties of Crumb Rubber Concrete

V. John Sundar Raj

Assistant Professor, Department of Civil & Structural Engineering, SCSVMV, Enathur, Kanchipuram, India. Email: john2yohanan@gmail.com

ABSTRACT

Concrete is the widely used building material in the construction, as well as the largest user of natural resources with annual consumption of 20 billion tons. Basically, it consists of aggregates which are bonded together by cement and water. The major part of concrete besides the cement is the aggregate. Aggregate include Coarse (crushed stone / Gravel) and Fine (River Sand). Use of these conventional materials in concrete is likely to diminish the resources unless there is a suitable substitute. Rubber which is generated in large quantities as waste does not have useful disposal till now. But rubber is found to possess properties that are required for viable replacement of fine aggregate in concrete. Hence, we in this project have aimed to study the efficiency of rubber as substitute for fine aggregate and utilize the crumb rubber (Crushed tyre rubber) in concrete, to minimize global warming. Aggregate properties such as specific gravity, water absorption, acid resistance was to be conducted to ascertain the properties concrete specimens were to be casted and tested for concrete mix with various percentage of replacement (5%,10% &15%) and its viability for replacement are discussed in this project.

KEYWORDS: Crumb rubber, Compressive strength, Splitting tensile strength, Flexural Strength.

***Corresponding author:**

V. John Sundar Raj

Assistant Professor,

Department of Civil & Structural Engineering,

SCSVMV, Enathur,

Kanchipuram, India.

Email: john2yohanan@gmail.com

I.INTRODUCTION

The use of rubber product is increasing every year in worldwide. India is also one the largest country in population exceeds 100cr. So the use of vehicles also increased, according to that the tyres for the vehicles also very much used and the amount of waste of tyre rubber is increasing. This creates a major problem for the earth and their livings. For this issue, the easiest and cheapest way of decomposing of the rubber is by burning it. This creates smoke pollution and other toxic emission and it create global warming. Currently 75-80% of scrap tyres are buried in landfills. Only 25% or fewer are utilized as a fuel substitute or as raw material for the manufacture of a number of miscellaneous rubber goods. Burying scrap tyres in landfills is not only wasteful, but also costly. Disposal of whole tyre has been banned in the majority of landfill operations because of the bulkiness of the fires and their tendency to float to the surface with time. Thus, tyres must be shredded before they are accepted in most landfills. So many recycling methods for the rubber tyre are carried according to the need. From this one of the processes is to making the tyre rubber in to crumb rubber. It is used in many works such as Road construction, Mould making etc

II.EXPERIMENTAL INVESTIGATION

Materials

Cement

Ordinary Portland cement of 53 grade confirming was used in the present study. The properties of cement are shown in Table 1.

Table 1 Properties of Cement

Sl.No	Property	Result
1	Initial Setting time	35min
2	Specific Gravity	3.148
3	Fineness Modulus	1.5%

Fine Aggregate

Natural sand as per IS: 383-1987 was used. Locally available river sand having bulk density 1860kg/m^3 was used. The properties of the fine aggregate are shown in Table 2.

Table 2 Properties of Fine Aggregate

Sl.No	Property	Result
1	Specific Gravity	2.5
2	Fineness Modulus	2.4%
3	Water Absorption	0.50%

Coarse Aggregate

Crushed aggregate confirming to IS: 383-1987 was used. Aggregate of size 20mm of specific gravity 2.66 and fineness modulus are shown in Table 3.

Table 3 Properties of Coarse Aggregate

Sl.No	Property	Result
1	Specific Gravity	2.66
2	Fineness Modulus	6.7%
3	Water Absorption	2.4%

Crumb Rubber

The properties of crumb rubber are shown in Table 4.

Table 4 Properties of Crumb Rubber

Sl.No	Property	Result
1	Specific Gravity	1.68
2	Fineness Modulus	4.5%
3	Water Absorption	2%

Mix Proportioning

Concrete mix design in this experiment was designed as per the guidelines in IS 10262-2009. All the samples were prepared using design mix. M30 grade of concrete was used for the present investigation. Mix design was done based on I.S 10262-2009. The table 5 shows mix proportion of concrete (Kg/m^3)

Table 5 Mix proportioning

Water	Cement	Fine Aggregate	Coarse Aggregate	
160litres	380.95 Kg/m^3	696.71 Kg/m^3	1169.72	Kg/m^3
0.42	1	1.82	3.07	

III.EXPERIMENTAL PROCEDURE

The specimen of standard cube of (150mmx150mmx150mm) and standard cylinders of (300mmx150mm) and prisms of (100mmx100mmx500mm) were used to determine the compressive strength, split tensile strength and flexural strength of concrete. Three specimens were tested for 7&28 days with proportion of crumb rubber replacement. Totally 24 cubes, 24 cylinders and 24 prisms were cast the strength parameters and 12 cubes for acid attack test. The constituents were weighed and the materials were mixed by hand mixing. The water cement ratio was 0.42.

Experiments Conducted

The following experiments are conducted on the specimen cast.

- Compression test
- Splitting tensile test
- Flexural test

Specimen Details

From the study of the past literatures, the conventional concrete grade was chosen as M30 for replace the crumb rubber in the fine aggregate. Tests for physical properties of the materials have done and the mix ratio for the concrete was calculated by the materials properties as 1:1.82:3.07 and the water to cement ratio of 0.42% had been chosen.

IV. Results and Discussion

The normal and crumb rubber concrete are tested for their performance by determining their compressive strength, splitting tensile strength and flexure strength development at different ages of 7^{th} and 28^{th} days. The results obtained are discussed in detail in the following sections.

Compressive Strength

The limit of compressive strength of the cement concrete depends on both, the strength of the matrix and the particle tensile strength of the aggregate. The strength of the concrete is usually related to the cement content and water to cement ratio. However, in this study the crumb rubber is partially replaced with fine aggregate and test the strength under compression. The compression strength of the concrete at 7^{th} and 28^{th} day were conducted is given in Table 6.

Table 6 Compressive strength of normal and crumb rubber concrete.

Replacement of Fine Aggregate by crumb rubber	7 days(N/mm^2)	28 days(N/mm^2)
0%	24.32	37.2
5%	27.10	37.76
10%	24.52	35.32
15%	19.52	29.02

Splitting tensile strength

The splitting tensile strength of the crumb rubber concrete with the different percentage replacement of crumb rubber by fine aggregate in normal concrete at the 7^{th} and 28^{th} day results were to be tabulated in Table 7.

Table 7 Splitting tensile strength of normal and crumb rubber concrete.

Replacement of Fine Aggregate by crumb rubber	7 days(N/mm^2)	28 days(N/mm^2)
0%	3.05	4.08
5%	2.75	3.50
10%	2.3	2.96
15%	2.0	2.59

Flexural Strength

The flexural strength of the normal and crumb rubber concrete for the different proportions of crumb rubber in fine aggregate at 7^{th} and 28^{th} day results were given in the Table 8.

Table 8 Flexural strength of normal and crumb rubber concrete.

Replacement of Fine Aggregate by crumb rubber	7 days(N/mm^2)	28 days(N/mm^2)
0%	6.02	7.91
5%	5.75	6.95
10%	5.00	5.78
15%	4.96	5.46

V.CONCLUSION

From this study the effective utilization of rubber tyre waste has been developed and it made to use in the concrete mixture as fine aggregate. At present the crumb rubber production in the south India is very less than north. So, the material availability was less, because of less knowledge about that. Based on the test results the following conclusions were made. These can also include non-primary structural applications of medium to low strength requirements, benefiting from other features of this type of concrete.

Even if rubber tyre aggregate was used at relatively low percentages in concrete, the amount of waste tyre rubber could be greatly reduced due to the very large market for concrete products worldwide. Therefore, the use of waste tyre rubber aggregates in concrete shows promise for developing an additional direction for used tyres.

- The compressive strength of crumb rubber concrete with 5% replacement is 37.76 N/mm^2; it is higher than the strength of normal concrete (37.20N/mm^2) on 28^{th} day.
- The compressive strength of crumb rubber concrete with 10% replacement, it gives acceptable strength of 35.32 N/mm^2
- In splitting tensile strength, the strength of crumb rubber concrete is lower than the strength of normal concrete.
- In the flexural strength test conducted on crumb rubber concrete it shows a decrease in strength when compared to the strength of normal concrete.

- From the test results, it is found that the crumb rubber possesses less bonding ability which has affected on the strength of the concrete.

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